

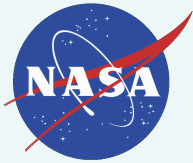
NASA Global Hawk: A New Tool for Earth Science Research



CDR Phil Hall, NOAA
Deputy Project Manager
6 May 2009



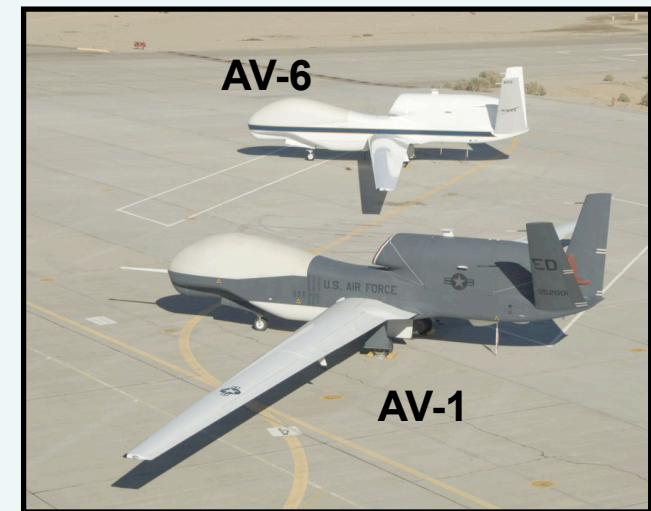
NASA Dryden Aircraft Fleet
November 2008



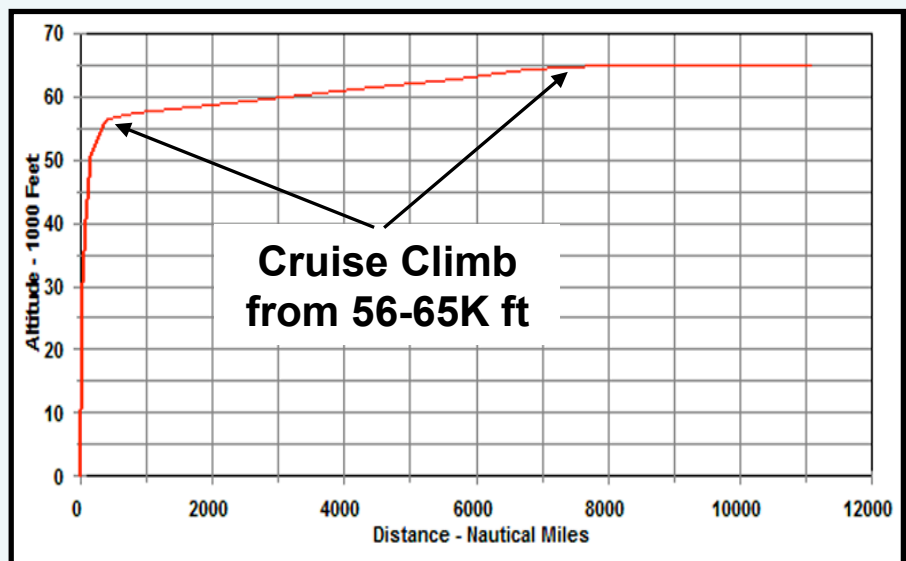
NASA Global Hawk System

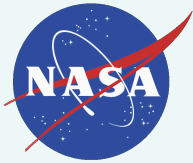


- Two USAF Pre-Production Global Hawk aircraft were transferred to NASA in September 2007.
- The aircraft are based and operated from Dryden Flight Research Center on Edwards Air Force Base.
- A combined NASA/Northrop Grumman team is maintaining, modifying, and operating the UAS.
- Flight Operations begin in May 2009.
Science Missions begin in June 2009.



Endurance	> 30 hours
Range	>11,000 nmi
Service Ceiling	65,000 ft
Airspeed (55K+ ft)	335 KTAS
Payload	1,500 lb
Length	44 ft
Wingspan	116 ft

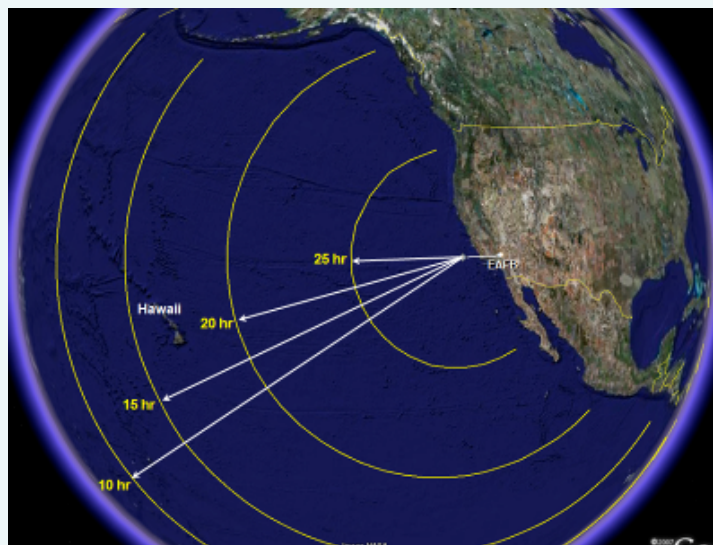
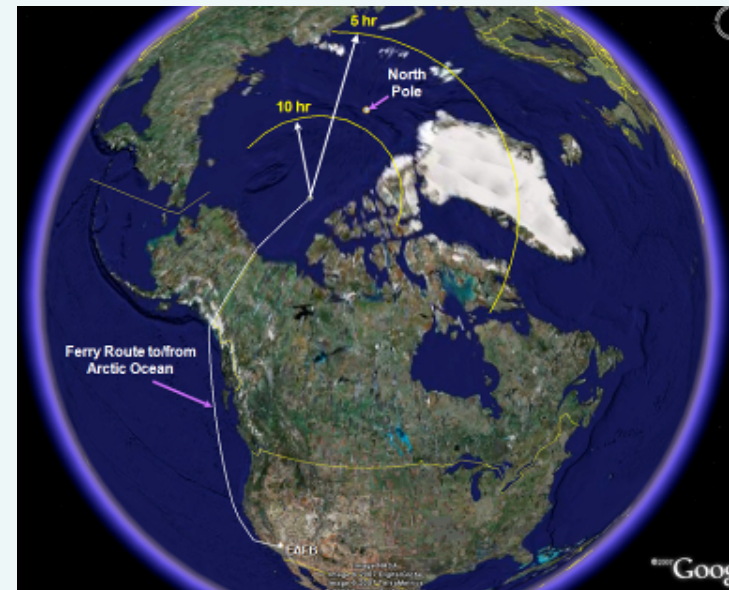


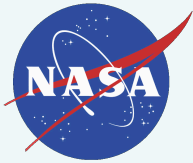


Baseline Mission Capability



- Missions originate and conclude at Edwards Air Force Base.
- Long-duration missions will be conducted in the Arctic, Pacific and Western Atlantic Oceans.
- The arcs represent on-station dwell times before return to base.





NGC / NASA Partnership



NASA Space Act Agreement:

- 2008 – 2013: Share costs and access
- NASA focus is Earth & Atmospheric Science
- Northrop Grumman focus is new capability developments and DoD customers

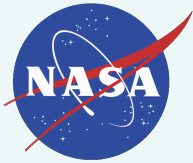
Currently in Stand-Up Phase

- Assembling new infrastructure
- Phase inspections and aircraft modifications
- New ground control station development

Flight Missions Planned

- July 2009 - Global Hawk Pacific (GloPac) Scientific Campaign
- Summer 2010 - Hurricane Research Missions for NASA Genesis and GRIP Campaign
- 2010 - NASA Jet Propulsion Laboratory UAV SAR





NASA/NOAA Partnership



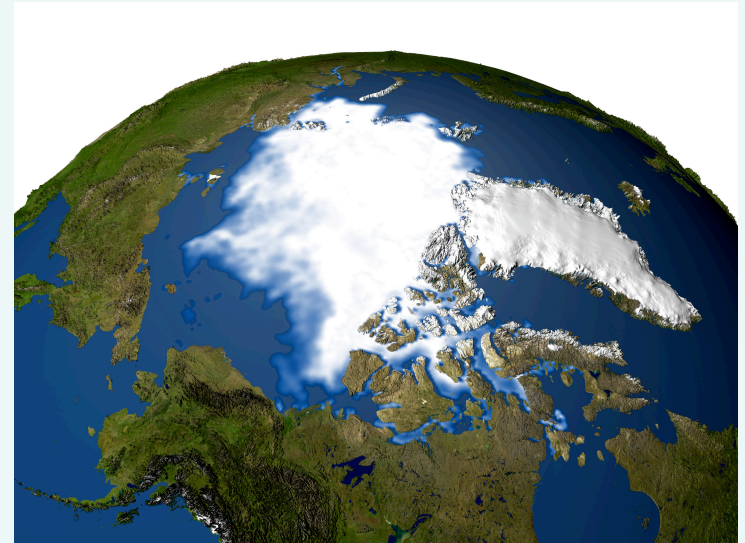
NOAA and NASA Partnership

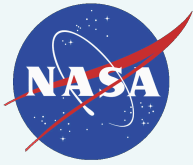
- Joint participation in science data gathering missions
- NOAA provides scientific instrumentation to compliment NASA instrumentation
- 3 year agreement

CDR Phil Hall on 4 Year Detail to Dryden

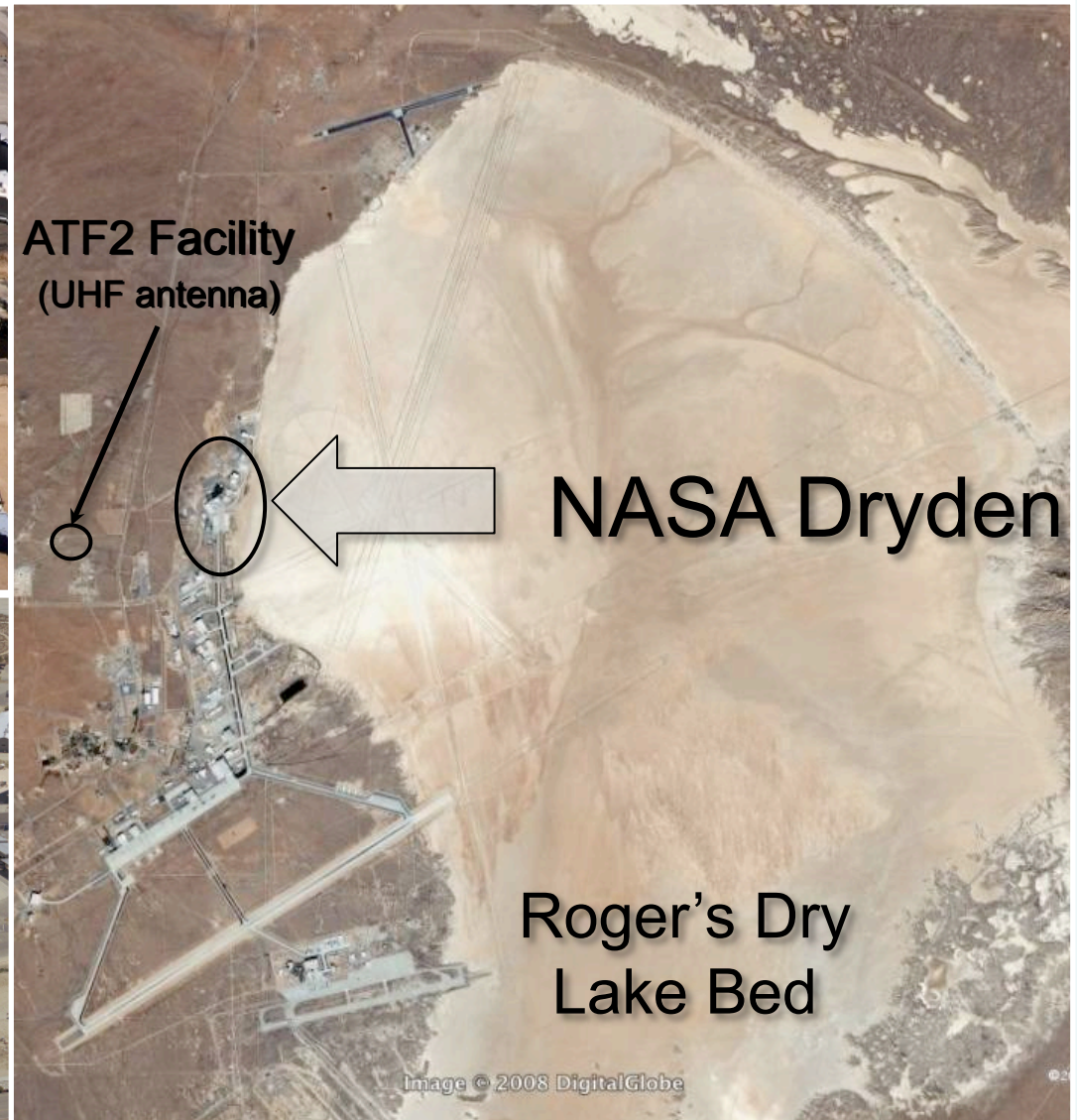
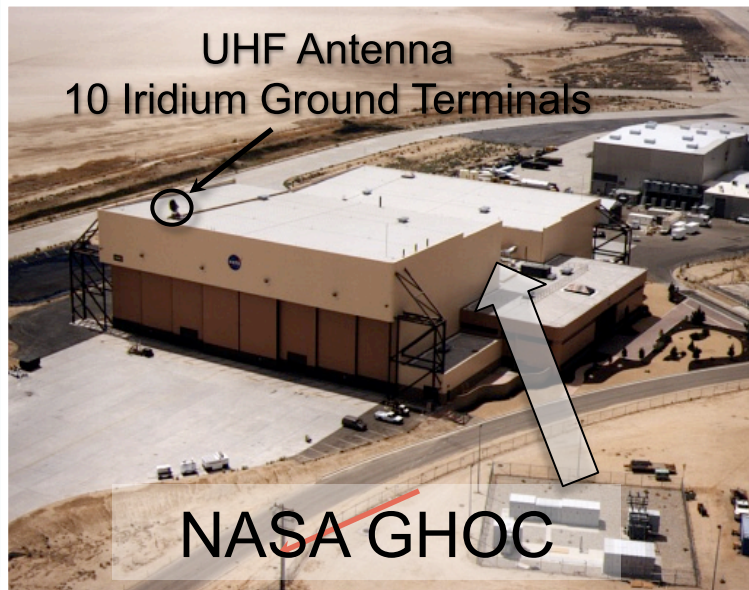
- Deputy Project Manager
- Global Hawk pilot
- Mission planning and coordination

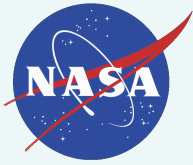
NOAA is funding the development of a dropwindsonde capability for Global Hawk .



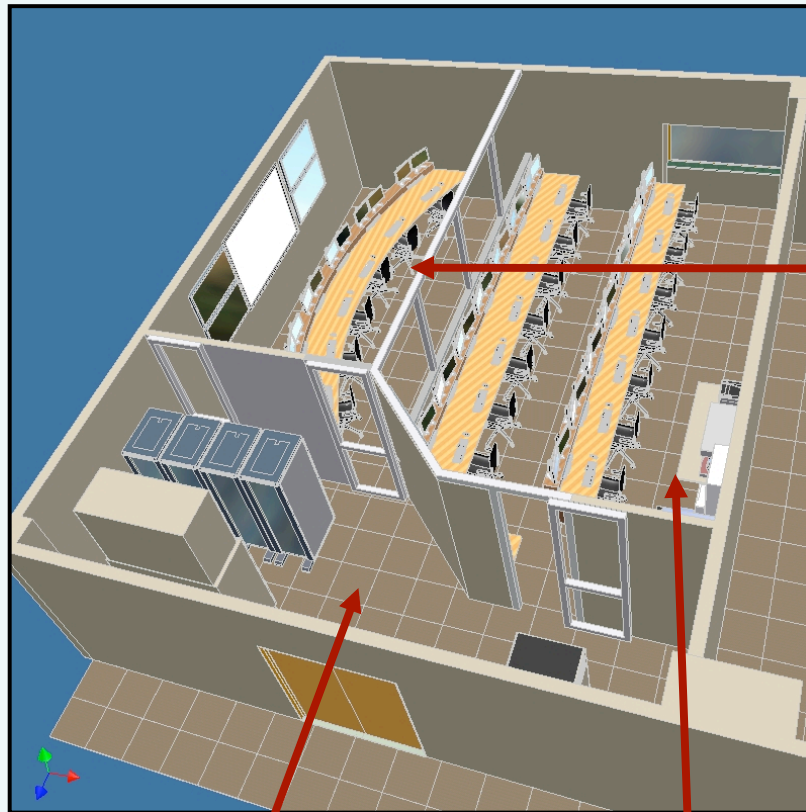


Edwards Air Force Base and NASA Dryden Flight Research Center





DFRC Global Hawk Operations Center (GHOC)



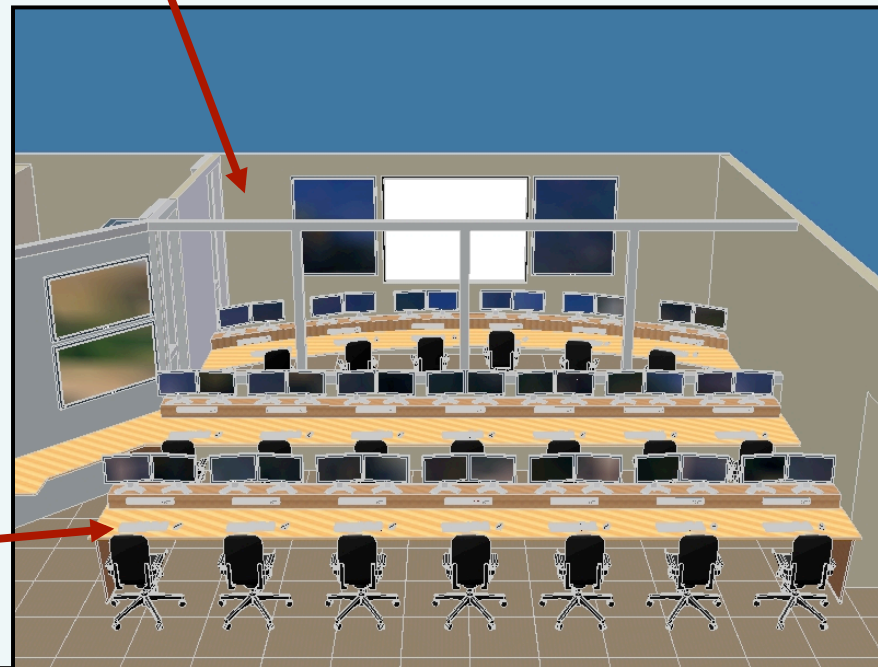
Support
Equipment
Room
(SER)

Payload
Operations
Room
(POR)

Flight
Operations
Room
(FOR)

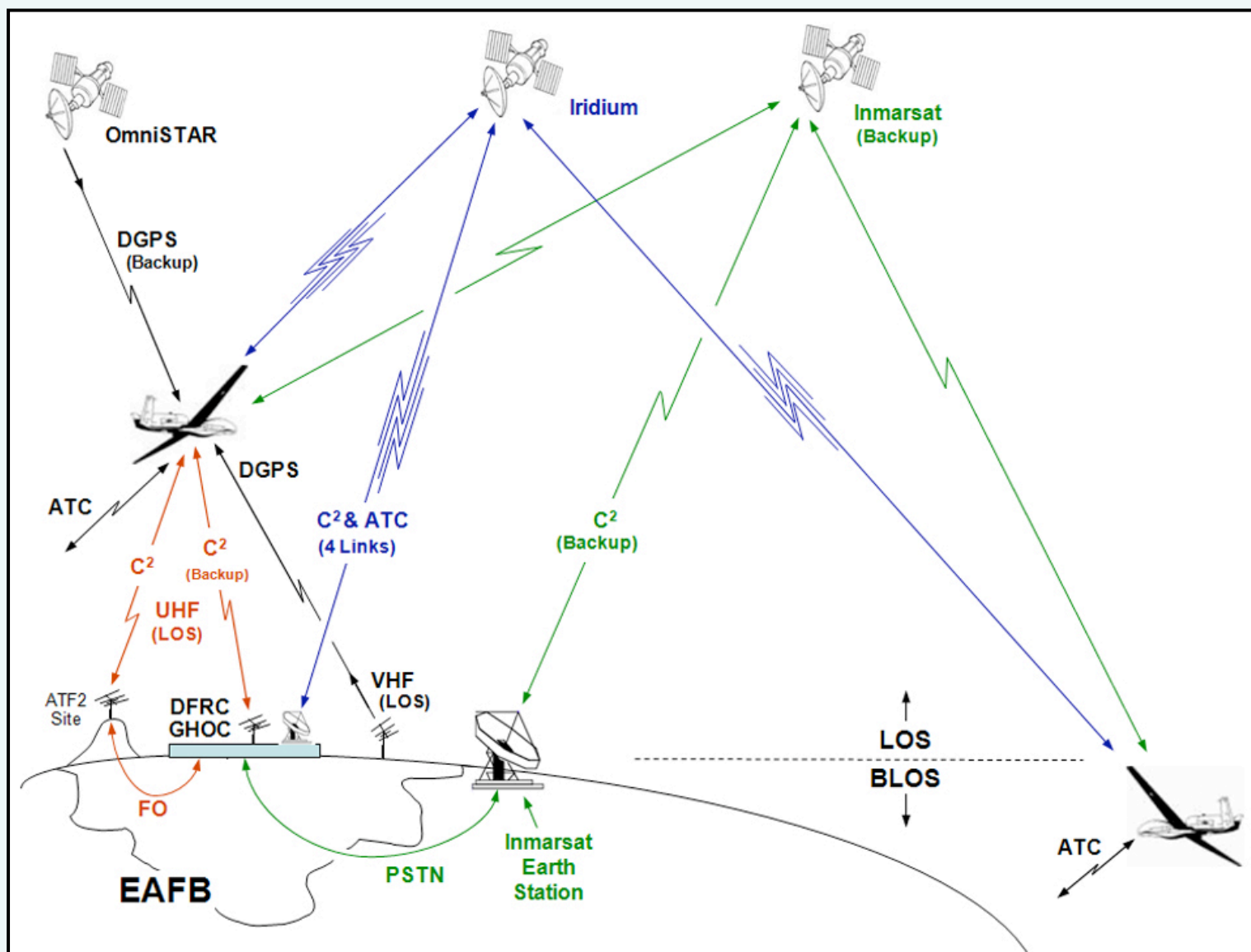


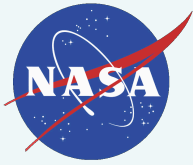
Photo Provided by NGC





Flight Control and Air Traffic Control Communications Architecture

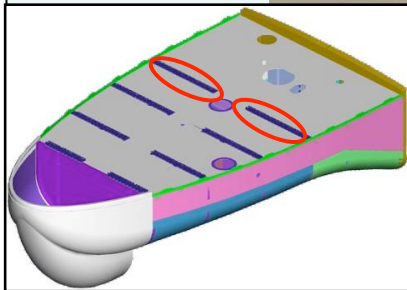
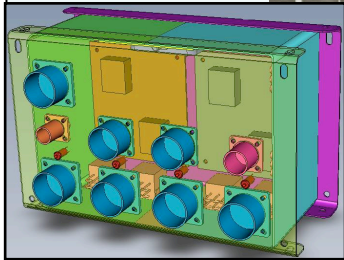




Payload Integration and Accommodations



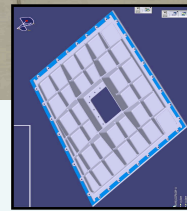
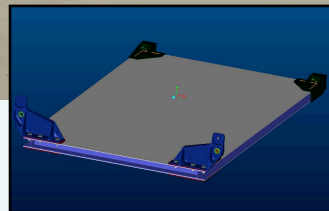
Experiment Interface Panel & Ethernet Switch



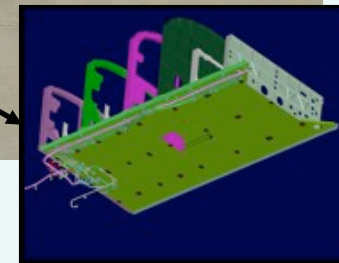
Mounting Rails



**Bay Under
the Nose**



Pallets and Hatches

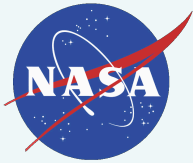


Mounting Hard Points

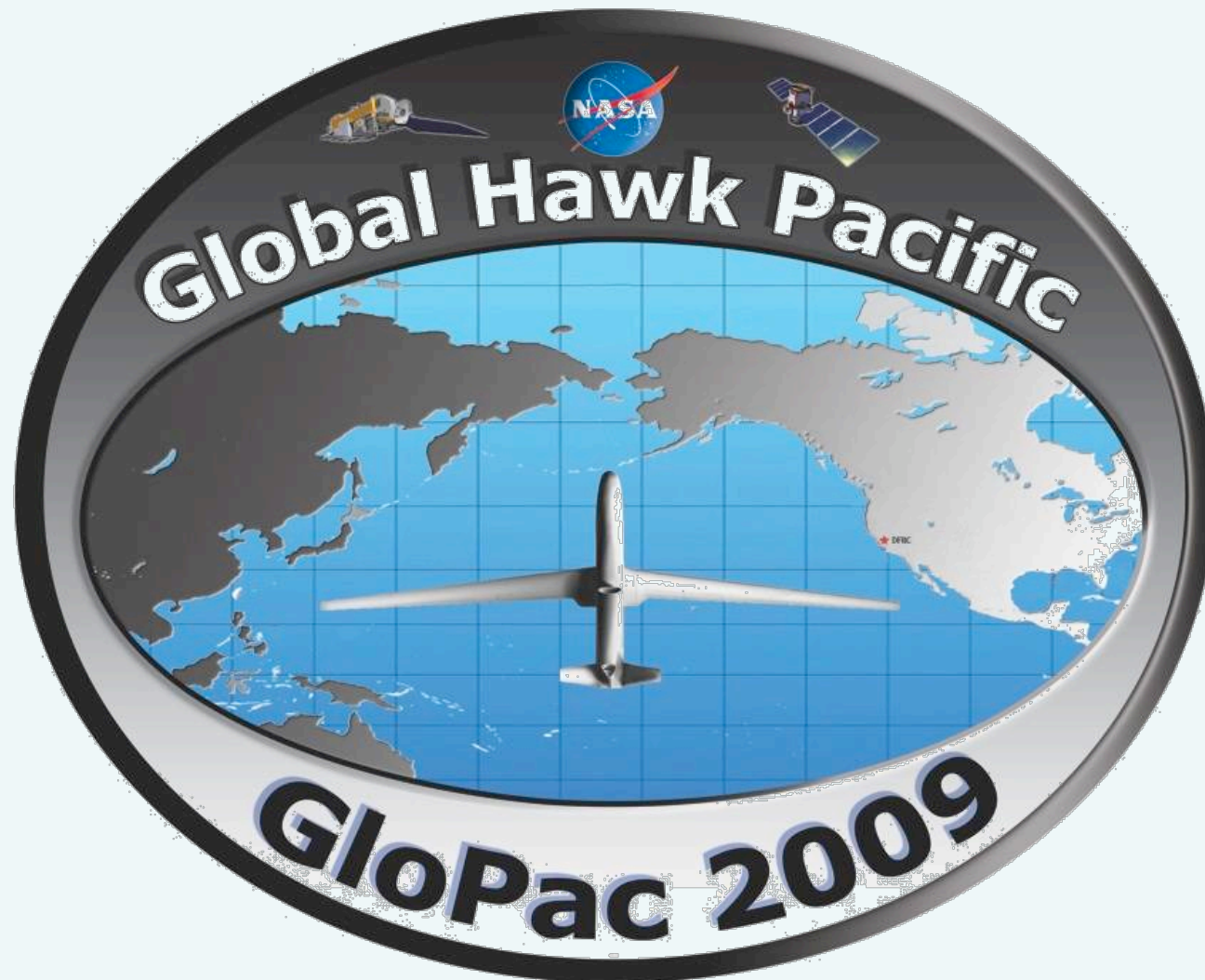


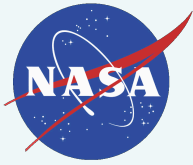
**Wing Pods
(future capability)**





Initial Science Mission

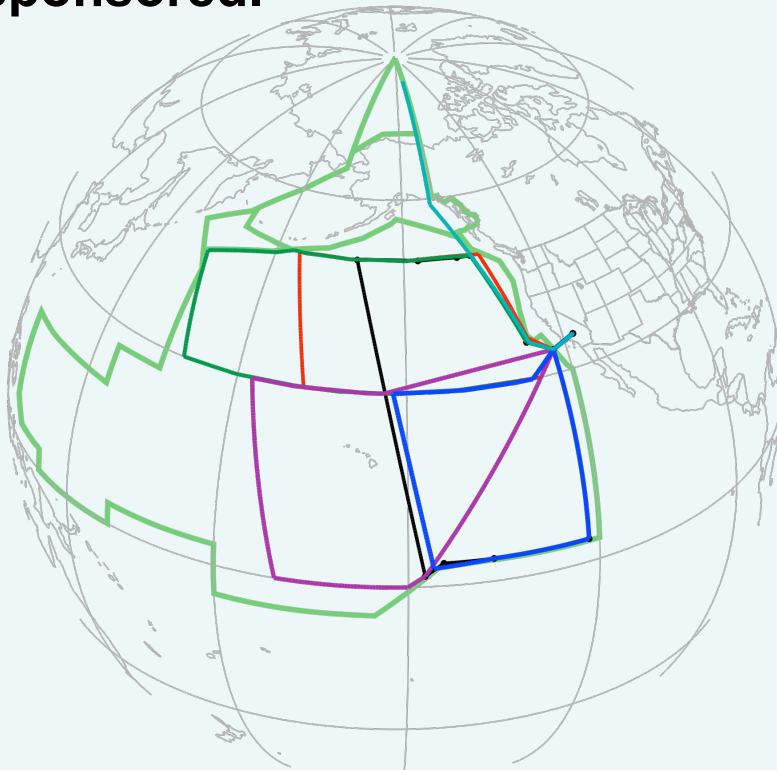




Global Hawk Pacific Science Campaign (GloPac 2009)

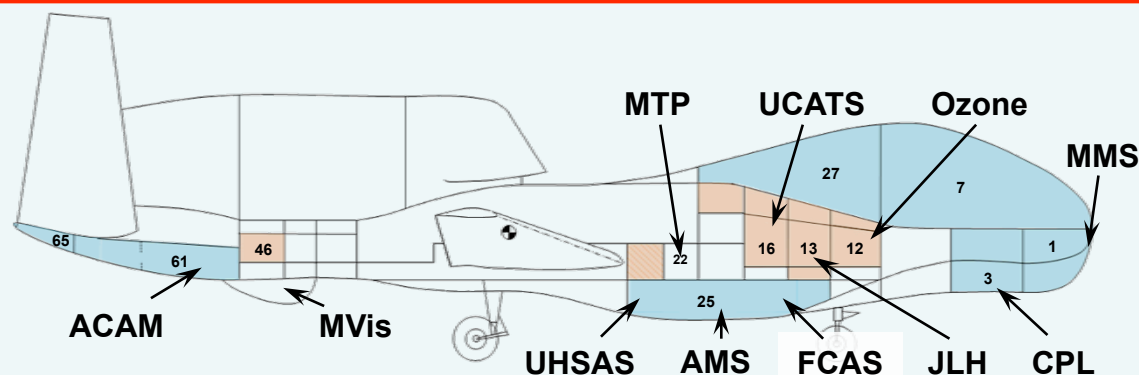


- Flights planned for Summer 2009.
- Flights will be conducted over the Pacific Ocean, and possibly over parts of the Arctic.
- 12 instruments, NASA and NOAA sponsored.

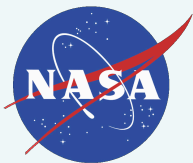




GloPac 2009 Payloads



- ACAM** - Cross-track scanning spectrographs of NO_2 , O_3 , & aerosols.
- AMS** - Multi-spectral scanner for upper tropospheric water vapor meas.
- CPL** - Backscatter LIDAR for hi-res profiling of clouds & aerosols.
- FCAS** - Aerosol size and concentration measurements.
- MMS** - Science quality aircraft state variable measurements.
- MTP** - Passive microwave radiometer meas. of O_2 thermal emissions.
- MVis** - Time-lapse nadir color digital imagery w/ georeferencing.
- Ozone** - Dual-beam UV photometer for accurate O_3 measurements.
- UCATS** - Dual gas chromatographs for N_2O , SF_6 , H_2 , CO , & CH_4 meas.
- UHSAS** - Ultra-high sensitivity aerosol spectrometer.
- ULH** - In-situ hi-accuracy atmospheric water vapor measurements.

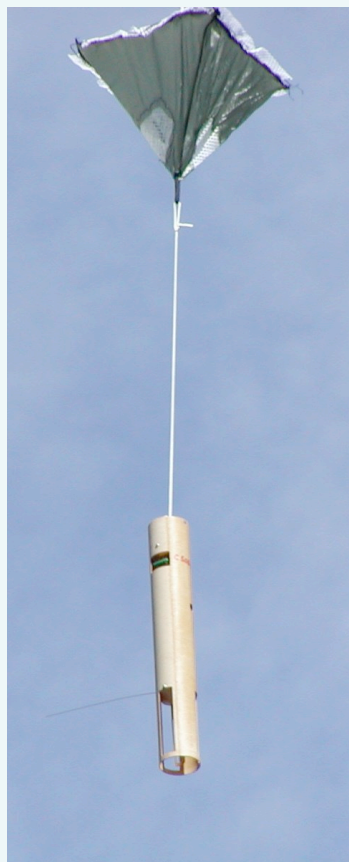


Proposed Payloads (cont)

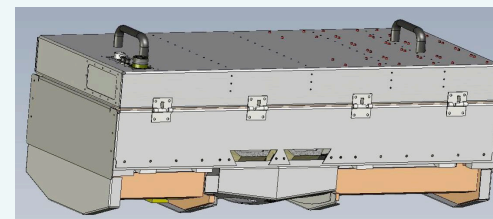


UAV-SAR(JPL)

Reconfigurable polarimetric L-band SAR designed for repeat pass deformation measurements (currently on NASA G III).

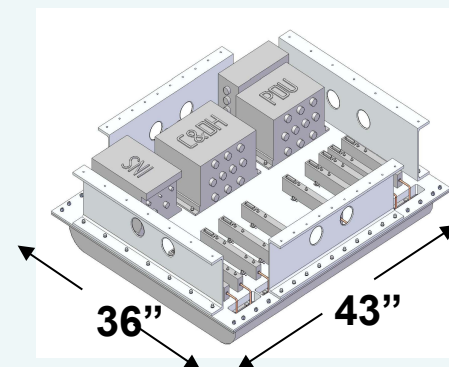


Dropwindsonde Dispenser (NOAA)



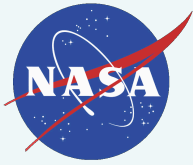
HAMSR (JPL)

Microwave Sounder providing 3D measurements of temperature and Water vapor content.



HIRAD (MSFC)

Hurricane Imaging Radiometer for high resolution measurements of ocean surface vector winds.



Summary



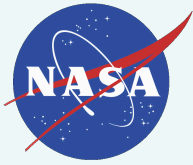
- **NASA Dryden owns two Global Hawk aircraft.**
- **A ground control station has been constructed.**
- **Preparations for initial flights are nearly complete.**
- **Flights within the EAFB range will begin in May 2009.**
- **Customer flights begin in July 2009.**





Backup Slides





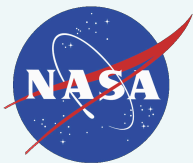
Payload Integration and Accommodations (cont)



On-Site Customer Accommodations



- Re-configurable work area in the hangar.
- Access to meeting room, phones, fax, copy machine, printer.
- Wireless internet.
- Shop support.
- Environmental testing support.
- NASA and Northrop Grumman Mechs and Techs.
- Hangar is networked to the Global Hawk Operations Center.

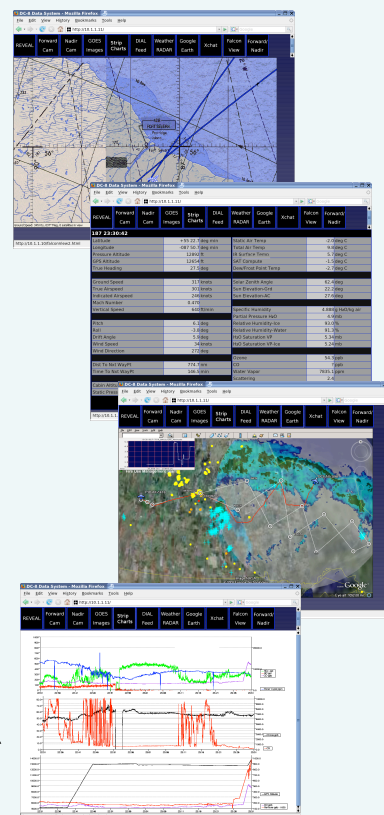
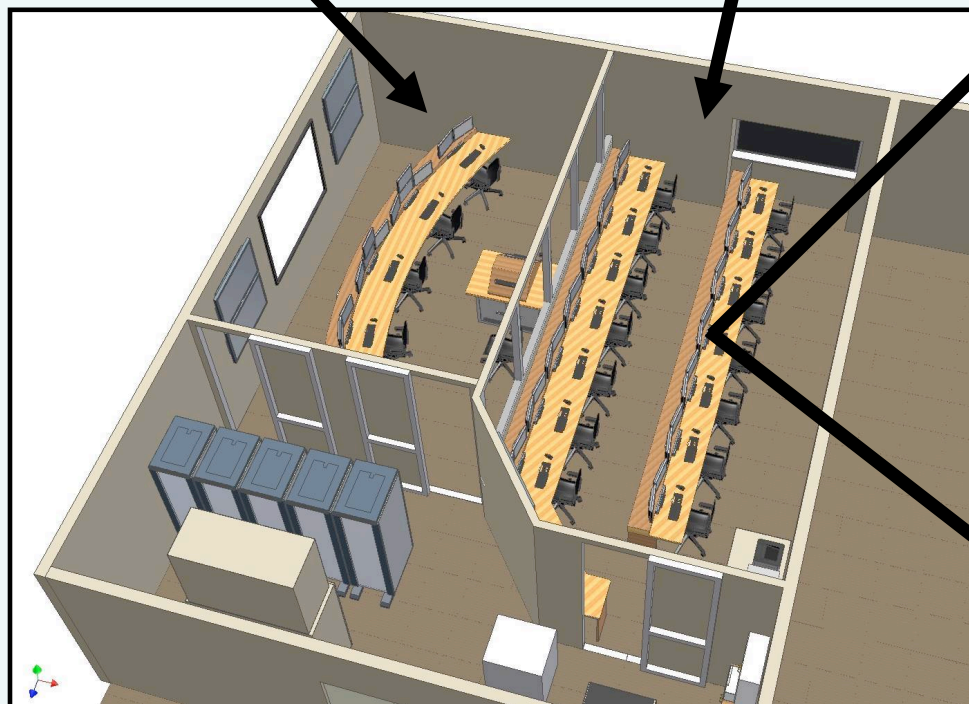


Global Hawk Operations Center Payloads Operations Room



Flight Operations
Room

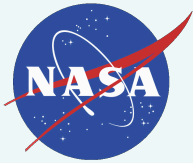
Payload Operations
Room (12 PI Stations)



Display
Examples

Common Core Services

- Bi-Directional Comms with Payloads.
- Payload Data Telemetry.
- PI contributed displays accommodated.
- PI provided laptops accommodated.
- Internet Relay Chat (IRC).

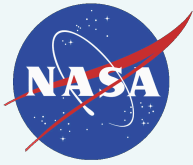


NASA Global Hawk Deployment Considerations



Infrastructure Required

- **Portable ground control station (GCS) support.**
 - Concrete or asphalt pad for the GCS trailer.
 - Power (2 KVA 120/208 VAC, 3 phase) with UPS.
 - Analog phone lines (minimum of 5).
 - Location for antennas (UHF-LOS, ATC-LOS, DGPS, Iridium).
- **Facilities at deployment site.**
 - 8000 ft x 150 ft runway (minimum).
 - Taxiways that can accommodate 116 ft wingspan, with margin.
 - Hangar and maintenance infrastructure.
 - Accommodations nearby for the visiting crew (minimum of 8 people).
- **Personnel from NASA/NGC that will support the deployment.**
 - Maintenance and flight prep crew (4-5 people).
 - Flight operations crew (2-3 people).
 - Payload support personnel (number depends on customer requirements).



NASA Global Hawk Deployment Considerations



Mission Preparation and Global Hawk Operational Constraints

- Mission prep unique to deployment site (in place before deployment begins).
 - Certificate of Authorization (COA) for flights to and from deployment site.
 - Survey of runway and taxiways -- precise coordinates for autonomous operations.
 - Mission plans, including contingency planning.
 - Local frequency coordination.
 - Line-of-site aircraft command and control (UHF).
 - Line-of-site air traffic control (UHF/VHF).
 - Differential GPS (VHF).
 - Payload line-of-site data telemetry (depends on customer requirements).
- Global Hawk Flight Restrictions
 - No flight in icing, precipitation, or clouds (VFR flight only).
 - Generally, restricted airspace to 18,000 ft MSL or chase aircraft is required.
 - Maximum landing crosswind component is 15 knots.



Global Hawk UAS

Notional Mission Profile

